

CLAIMS

1. A high-strength hot-rolled steel sheet excellent in hole expandability, and ductility, containing in terms of a mass%:
- 5 C: 0.01 to 0.09%,  
Si: 0.05 to 1.5%,  
Mn: 0.5 to 3.2%,  
Al: 0.003 to 1.5%,  
P: 0.03% or below,  
10 S: 0.005% or below,  
Ti: 0.10 to 0.25%,  
Nb: 0.01 to 0.05%, and  
the balance consisting of iron and unavoidable impurities;
- 15 satisfying all of the following formulas <1> to <3>:  
$$0.9 \leq 48/12 \times C/Ti < 1.7 \quad . . . <1>$$
$$50,227 \times C - 4,479 \times Mn > -9,860 \quad . . . <2>$$
$$811 \times C + 135 \times Mn + 602 \times Ti + 794 \times Nb > 465 \quad . . . <3>, \text{ and}$$
- 20 having strength of at least 980 N/mm<sup>2</sup>.
2. A high-strength hot-rolled steel sheet excellent in hole expandability and ductility, containing in terms of a mass%:
- 25 C: 0.01 to 0.09%,  
Si: 0.05 to 1.5%,  
Mn: 0.5 to 3.2%,  
Al: 0.003 to 1.5%,  
P: 0.03% or below,  
S: 0.005% or below,  
30 Ti: 0.10 to 0.25%,  
Nb: 0.01 to 0.05%,  
at least one of  
Mo: 0.05 to 0.40% and V:0.001 to 0.10%, and  
the balance consisting of iron and unavoidable  
35 impurities;  
satisfying all of the following formulas <1>' to <3>':  
$$0.9 \leq 48/12 \times C/Ti < 1.7 \quad . . . <1>'$$

$$50,227 \times C - 4,479 \times (Mn + 0.57 \times Mo + 1.08 \times V) > -9,860 \quad . . . <2>'$$

$$811 \times C + 135 \times (Mn + 0.57 \times Mo + 1.08 \times V) + 602 \times Ti + 794 \times Nb > 465 \quad . . . <3>, \text{ and}$$

5 having strength of at least 980 N/mm<sup>2</sup>.

3. A high-strength hot-rolled steel sheet excellent in hole expandability and ductility according to claim 1 or 2, which further contains, in terms of mass%, 0.0005 to 0.01% of at least one of Ca, Zr and REM.

10 4. A high-strength hot-rolled steel sheet excellent in hole expandability and ductility according to any of claims 1 through 3, which further contains, in terms of mass%, 0.0005 to 0.01% of Mg.

15 5. A high-strength hot-rolled steel sheet excellent in hole expandability and ductility according to any of claims 1 through 4, which further contains, in terms of mass%, at least one of:

Cu: 0.1 to 1.5% and

Ni: 0.1 to 1.0%.

20 6. A production method of a high strength hot rolled steel sheet excellent in hole expandability and ductility according to any of claims 1 through 5, comprising the steps of:

25 finishing hot rolling by setting a rolling end temperature to from an Ar<sub>3</sub> transformation point to 950°C;

cooling a hot rolled steel sheet to 650 to 800°C at a cooling rate of at least 20°C/sec;

30 cooling then the steel sheet for 0.5 to 15 seconds;

further cooling the steel sheet to 300 to 600°C at a cooling rate of at least 20°C/sec; and coiling the steel sheet.